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AUTHOR Feldmann, Shirley: And Others
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ABSTRACT

Thirty-eight college students were the subjects of a study designed to examine the efficacy of training graduate reading specialists through a diagnosis simulation program versus the use of a traditional child study approach. The major task of this investigation was to compare, by way of univariate or multivariate analysis, various combinations of simulation program-child study approaches. The sequential, hierarchical, and systematically structured computer simulation of human cognition (Simon, 1979) formed the basis of the present simulation program. It was expected that those students involved in some aspect of the simulation would demonstrate superior skills by scoring higher on a post-treatment measure of diagnostic abilities than students involved only in traditional child studies. It was found that students in the child study simulation group scored significantly higher than students in the child study group on only parts one and four of the final exam. This finding supported the contention that a specific form of simulation can benefit students who are being trained to do reading diagnosis, and can serve as a useful adjunct to the traditional practicum experience. (MER)

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USE OF A SIMULATION PROGRAM FOR TEACHING GRADUATE READING DIAGNOSTIC SKILLS

by

Shirley Feldmann
Dennis Alne
Joel Seltzer

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Use of a Simulation Program for Teaching Graduate Reading Diagnostic Skills [1.]

Shirley Feldmann, Graduate Schoo, CUNY

Dennis Alne, Graduate School, CUNY

Joel Seltzer, Graduate School, CUNY

One of the most widespread concerns in education today is that of declining reading achievement. Although blame for this decline has been leveled at educators, parents and children alike, the criticism has been taken as a call-to-arms among those responsible for training graduate reading specialists. A major component in the training for these graduate students is supervised work with pupils for purposes of building competence in diagnostic skills. Most practicum courses, however, are costly and time consuming and, in addition, often give students insufficient experience in dealing with the diverse complexities found among poor readers. A promising alternative to use of the child case study practicum in diagnostic training is the simulation program.

Simulation programs have been employed extensively for training in medical schools and some business institutes. As an outgrowth of information processing theory, simulation models of the human thinking process have provided educators with a prognostic tool for teaching complex skills in an ordered way. Only recently, though, have graduate schools of

1. This paper is an expanded version of the talk given at the 1980 Northeastern Educational Research Association Convocation, Ellenville, New York. The study reported was supported by a City University PSC-BHE Faculty Award for 1979-80.

of education utilized technological and/or computer models of human thought and, more specifically, concerned themselves with simulation programs; there have been no simulation programs for training reading diagnostic skills to date.

The purpose of the present study was to examine the relative efficacy in the training graduate reading specialists of a diagnosis simulation program versus the use of a traditional child-study approach. Various combinations of both training approaches were explored.

Background of the Problem

Educators and psychologists have extensively investigated both factors influencing learning and strategies of learning, and have speculated about the mechanisms of the learning process on both theoretical and applied levels. In order to understand better the actual thinking process, information-processing theorists have developed working models of human problem-solving abilities. Simon (1979) and Anzai and Simon (1979 have recently summarized over a decade's work on human cognitive processes which use computer simulations of learning and problem-solving. They provide a comprehensive theoretical framework to explain these processes as well as suitable model for testing the pragmatic applications of such a theory. Thus, information-processing theorists have adopted the computer as both a tool to aid thinking processes and as an analogue of how the mind handles data.

It is in the area of a diagnosis that the computer has served well in both roles. Clinical diagnosis is a complex procedure that involves information-gathering (an input stage), testing and sorting of data (a process stage with internal feedback), and categorization in diagnostic terms (output stage). The adaptation of this traditionally-viewed intuitive process of the clinician to the computer was skillfully executed by Kleinmuntz (1963) using psychiatric profiles. He felt that if the clinician was forced to make explicit the process by which clinical judgment is rendered then the process could be adopted for use by computer programs. Using MMPI profits, together with interviews and clinical judgments by psychiatrists, Kleinmuntz assembled the beginnings of a computer model of clinical diagnosis. It was an early attempt to define that elusive "artistic" sense of the diagnostician.

In a more sobering article that discussed the current limitations in making the computer a clinican, Kleinmuntz (1975) admitted that the computer cannot replace the human diagnostician. However, he proposed a computer simulation model of diagnostic problem-solving that shows promise as an aid to clinical judgment and as a teaching tool. Although Kleinmuntz did not employ his model as a clinical training paradigm, the current study followed this model in construction of its simulation materials.

The growth of simulation/game techniques was spurred on by the seminal work of Von Neumann (1947), inspiring researchers to apply it to educational situations. Zuckerman and Horn (1973) noted a 50% increase in availability of simulation programs for education from 1970 to 1972. Indeed, the rationale for use of simulations and its efficacy as a teaching tool was

increasingly demonstrated during this period, by, for example, Boocock and Schild, 1968; Kleitsch & Dodge, 1969; Barton, 1970 and Finch and O'Reilly, 1974.

Simulation programs have also been developed and investigated in other educational areas, including public health nursing (Williams, 1975), pedodontics (Machen, 1975), and guidance and counselling (Hummel, Lichtenberg & Schaffer, 1973; Lemire, 1976; and Goralski, 1979). In addition, medical educators (Selinger, Cohen & Schiffman, 1978) have recently developed a simulation package in human development to be used in training preclinical medical students. These simulation materials, constructed from interviews with the collaboration of medical experts, focused on teaching students strategies and techniques in problem-solving and in diagnostic reasoning.

Much like the disciplines cited above, the training of educational personnel has also involved the use of simulations but, apparently, to a lesser degree. Engin and Klein (1975) developed PSYCHSIM as a multimedia simulation package to train school psychologists. Attempts to train teachers using simulations were made by Anderson (1964), who found that simulations produced more student involvement than did case studies, and by Kelly (1968), who found that a simulation experience increased awareness of pupil reading levels. In addition, Seidner (1977) in summarizing the current literature recommended further investigations, a view supported by the results of simulation teaching procedure proposed by Breiter (1975).

The development of a true computer-based simulation to teach educational reading diagnosis, the model used in the present study, was accomplished by Wark (1968) and by Lerner and Schuyler (1974). In each study the students

interacted with sequentially presented material from the computer in order to form hypotheses, make decisions, and develop a diagnosis regarding a simulated child. Unfortunately, no data are available regarding the effectiveness of the Wark program; the Lerner and Schuyler study provides only attitudinal reactions by subjects to the simulation. In the latter study 80% of the students responded favorably to the program; a pre- and post-test questionnaire revealed significant positive attitude change on the part of Ss towards the computer-based technique. Although these studies come closest to empirically examining simulation procedures they did not compare simulation vs. case study approaches nor did they use an experimental design to control for treatment effects. The present study deals with these issues directly.

In summary, the literature suggests by way of demonstration, but without experimental control of treatment variables, that simulation programs might be useful in professional training. Little mention is made of these variables involved or their possible interactions in meeting the goals of the program. The major task of the present investigation was to compare, by way of experimental design, various combinations of simulation program-child study approaches. It was hoped that these empirical procedures would shed light on the issues concerning the relative efficacy of both approaches in the training of graduate reading diagnosticians. Specifically, it was expected that those students involved in some aspect of the simulation program would demonstrate superior skills by scoring higher on a post-treatment measure of diagnostic abilities than students involved in traditional child studies only.

Method

Subjects. City College students attending master's level courses in reading diagnosis in the 1979-80 semesters and Hunter College students in Spring 1980 were assigned to the various conditions. The City College students were randomly assigned to one of four conditions: two simulations; simulation followed by a child study; child study followed by a simulation child; two child studies. The Hunter College students were randomly assigned to one of three conditions: simulation followed by a child study; child study followed by a simulation; two child studies.

Students at City College participated in the simulation study as part of coursework, but students at Hunter College were asked to volunteer. All students agreed. Eleven students at City College participated in the Fall semester and 14 in the Spring semester; there were 13 students from Hunter College.

Materials

Two simulated case histories of children with reading problems were devised. The simulation materials consisted of background information from various people and sources concerned with each child in the form of questions and answers put on posterboards, as well as tests supposedly administered to each child. Two purposes were seen for the materials, to give practice in gathering information from various sources such as school personnel and tests, and to integrate such material into a reading diagnosis.

Background Information

Case "A" posterboards provided questions concerning the child's problem, with answers (underneath cardboard flaps), from ten sources: a child interview, the classroom teacher, a speech and hearing teacher, the school principal, the guidance counselor, a social worker, a classroom observation, the school records, a parent interview, and an afterschool homework center director. Case "C" posterboards provided questions and answers from a more limited range of sources: a child interview, the classroom teacher, the guidance counselor, a classroom observation, the school records, and a parent interview.

Simulated tests

Copies of reading tests and interest and attitude tests, both standardized and informal, which had been supposedly administered to the two children were included in the simulation package. Qualitative information and raw scores were given, with the appropriate conversion tables for the standardized tests.

Dependent measures

A diagnostic summary sheets and a final exam question, both with essay formats, were developed with scoring keys. There were five parts to the simulation summary sheets, and four parts to the final exam question; each part was scored on a five point scale. The final exam question required the student to write a diagnosis based on a case study of a child with a reading problem. The format of this final measure was similar to the simulation treatment.

Feedback sheets

To facilitate students' learning experiences with the simulation, feedback sheets that listed acceptable answers required on the diagnostic summary sheet were given to the students. In addition, specific feedback to each student was included, explaining what questions were designed to elicit, such as 'On question one we wanted you to recognize the fact that there are often multiple factors involved in a child's reading problem.' Examples were given to show how a student's report could be improved: 'You merely listed factors instead of trying to show relationships among them where such relationships existed.' Performance was rated on each part from "excellent" through "poor". Diagnostic summary sheets were also given to students for their case studies of actual children; however no feedback was given on these reports.

Experience questionnaires

At the end of the term students were asked to list their professional experiences as teachers or diagnosticians. They were also asked to evaluate their simulation experience.

Procedure

In the Fall of 1979 small groups of students at City College were administered the simulation by two experimenters. In the Spring of 1980 one experimenter worked at Hunter College and the other at City College. Neither experimenter knew what condition students were assigned to at the other college. Students were seen either approximately the third week of the semester or three weeks before the semester ended, depending upon the condition they were assigned to.

Following an introductory statement students were told to review information from various sources noted on the posterboards during the session. In addition they would be given a test packet to review at home. They were to analyze both sets of information in order to fill out the diagnostic summary sheet. They were told to return the summary sheet within two weeks.

All students received case "A". Students doing two simulations also received case "C". Students using case "A" were told that they could "ask" questions of the sources as they wished to a total of forty questions. These forty answers were to come from not more than seven out of the ten sources available. This limitation was imposed to simulate actual practice when one can rarely ask all the questions or interview all the people desired. Students taking case "C" were told they could "ask" and receive answers to all the questions available. The order in which answers were "asked" was noted by the students for later study by the experimenters.

Fall 1979 simulation summary sheets were evaluated by two experimenters, while Spring 1980 summary sheets were evaluated by the experimenter assigned to the college. Approximately one week after receiving the simulation summary sheets, and following their evaluation, feedback sheets along with the summary sheets were returned to the students. Students were also asked to fill out diagnostic summary sheets for their case studies of real children. The summary reports of actual case studies also provided the experimenters with qualitative information. This information will be commented on later.

At the end of the term the final exam question was administered to the students, as a part of the class exam at City College but extraneous to the grading system at Hunter.

Final exams were scored by two experimenters and their scores were correlated as a measure of inter-rater reliability. The experimenters then went over all discrepancies in the scoring and agreed on a final score, which was used in the data analysis. In addition, course grades and instructor's grades on case studies of real children were recorded.

The data were analyzed by either a univariate or multivariate analysis of variance. All such analyses were performed in a regression framework to account for the unequal cell sizes.

Results

The first stage of the data analysis involved the establishing of inter-rater reliability. If wide discrepancies among raters' final exam scores existed the analysis of the data would be weakened by the subjectivity involved. The means and standard deviations of the Fall 1979, and Spring 1980 final exam scores are reported for both experimenters in Table 1. Spring 1980 scores are broken down by school. The correlations

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Insert Table 1 about here

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of the two experimenter's scores r (8) = .7767 for the Fall 1979, and r (25) = .7941 for the Spring of 1980 are highly significant and indicate a reasonably high degree of inter-rater reliability.

At City College students were assigned to all four conditions. At Hunter College students were assigned to three out of the four conditions. Before combining the data a 2 x 3 analysis of variance (school by condition) was performed. The analysis revealed no significant differences between schools, $F(1, 26) = .7253$ $p > .05$, nor significant interaction between school and condition, $F(2, 26) = 1.2302$ $p > .05$.

Since there were no significant differences between the schools on three conditions they shared it was thought reasonable to assume that they also would not significantly differ on the fourth condition. This condition had only been administered at City College.

Data were combined and an analysis of variance indicated no significant difference among conditions on the final exam question $F(3, 34) = 2.7209$[1] $p > .05$. Mean final exam scores for all four conditions are presented in Figure 1.

Insert Figure 1 about here

Following this each of the four parts of the final exam question were analyzed. A 2 x 3 multivariate analysis of variance indicated no significant differences between schools on the three conditions they shared $T^2 (1, 26) = .8956$ $p > .05$, nor significant interaction between school and condition $F(2, 26) = 4.6899$ $p > .05$. Therefore, as before, data were combined and a multivariate analysis of variance indicated that some linear combination of the dependent variables (parts of final exam question) evidenced significance $F(3, 34) = 7.1011$ $p < .05$. No post hoc group comparisons tested proved significant.

1. The results were significant at the .10 level.

Next, separate univariate analyses of variance were performed on each part, but none of these analyses proved significant. Figure 2 shows that parts one and four of the final exam question discriminated most among conditions.

Insert Figure 2 about here

Therefore, in an attempt to find the linear combination of parts that resulted in the significant findings, scores on parts one and four were combined. Analysis of variance indicated a significant difference among conditions on this combination of final examination parts $F(3, 34) = 3.8443$ $p < .05$. Post hoc analyses are reported in Table 2. A significant difference

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Insert Table 2 about here

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was found only between the child-sim and child-only conditions $F(1, 20) = 11.1295$ $p < .05$. Students doing the simulation after their child studies had significantly higher scores on a combination of parts one and four of the final exam question than did students doing two child studies.

To check whether there might be differences in course grades for students in each of the four conditions, and/or differences in instructors' grades on case studies for students in the three relevant conditions further analyses of variance were performed. They indicated that there were no significant differences in either case, $F(3, 29) = 1.1004$ $p > .05$ and $F(2, 25) = .7341$ $p > .05$ respectively.

Discussion

It was expected that students receiving some form of the simulation experience would score higher on a post test treatment measure of diagnostic ability. While the mean scores for all three simulation conditions were higher than those of the child study they were not significantly different at the .05 level. However, it was found that students in the child study-simulation group scored significantly higher than students in the child study only group on parts one and four of the final exam question. This finding supported the contention that a specific form of simulation experience will benefit students who are being trained to do reading diagnosis.

Closer examination of these two parts of the final exam question suggests that the learning of specific aspects of doing a diagnosis was facilitated by participation in the simulation. Students in the child-simulation group were superior at identifying the multiplicity of factors involved in the reading problem presented and were also better able to integrate all the information into a diagnosis. This finding cannot be explained by a recency, effect, i.e., Ss doing the simulation prior to the final exam, since the simulation-only condition would also have shown superior results. A combination of the two techniques, i.e., simulation and child study, then, must be responsible for the significant findings.

One explanation for these results may be revealed by an examination of the Experience Questionnaire given to the students. A number of students recommended that the simulation be administered before the case study, as they felt such would provide a good foundation for learning how to gather

information when diagnosing a child. Perhaps it can inferred from these informal reports that the child study may present an overwhelming diagnostic task for the novice, and that the simulation provides a systematic, concrete and highly organized structure to deal wit future diagnoses. The results of this study would therefore suggest that students who had taken the case study first attempted to develop their own organizational structure in work with an actual child and therefore showed more benefit when such structure was provided in the follow-up simulation experience. In addition, a majority of the students indicated on the questionnaire that this combination of experiences seemed to result in optimum training.

The positive attitude towards the simulation experience was also shown by the fact that 87% of the students participating in this study found the experience to be helpful in learning how to diagnose reading difficulties. This is consistent with Lerner and Schuyler's (1974) attitudinal survey of their computer-based simulation which revealed that 80% of the subjects responded favorably to that program. Both simulation programs and the use of computer models show promise as a widely-recognized and exceptable technique for the training of professionals. The more objective data such as student performance, although scarce, also suggest positive results from simulation experiences (Anderson, 1964; Kelley, 1968; Engen and Klein, 1975).

On a theoretical level, the present study lends support to information-processing models of human problem-solving abilities. Although Kleinmuntz' (1975) "computer as clinician" has not been realized, the basic process of diagnostic problem-solving assumes the format of the input-interval

processing-output computer model of thinking. This sequential, hierarchical and systematically structured computer simulation of human cognition (Simon, 1979) formed the basis of the present simulation program. The need for such organized structure, shown by student attitude responses and actual performance on the final exam question, reinforces the use of a combined training paradigm for novice diagnosticians. It is here that theory and practical application mesh as one, i.e., the organization of the thinking a necessary condition for learning a complex skill such as diagnosing.

The simulation experience provides an alternative to the expensive and time-consuming aspects of practicum experience mentioned earlier. Students in the traditional practicum are supposedly learning how to utilize various sources of information when making a diagnosis. However, difficulties in gathering this information so often arise that this goal is rarely obtained. In the present study, students were asked to complete diagnostic summary sheets for their child case studies. Examination of these sheets revealed a paucity of information, other then test scores, related to the child's reading problem. Students' case study reports then failed to discuss other relevant issues involving the child's poor performance. The simulation program, on the other hand, provided this information in detail and was an aid in achieving the goal of teaching the student to gather information from many sources for diagnosis.

Instructors are often skeptical about incorporating new material into their course curriculum for fear that such will detract from time spent on course content. There is indication, however, that this simulation program can be easily worked into the course curriculum. At Fairleigh

Dickinson University in the Spring of 1979 the simulation program was utilized by the course instructor as a teaching aide in a beginning Master's level reading diagnosis course.[1] Materials were placed in the library with self-administration instructions. Eleven of the fourteen students in the class volunteered to take part in the simulation program. Simulation reports, feedback and final exam questions were evaluated by the experimenters. Students werre encouraged to work on the simulation materials in small groups. The instructor reported that there was no difficulties following instructions. Furthermore, all students taking part felt that the simulation was a useful learning experience. While the students participating in the simulation may not have been comparable to students in the class who did not participate the differences in mean scores on the final exam (72 and 38 respectively) is nevertheless informal evidence for the learning effect of the simulation experience.

Based on the results of this study a simulation experience was found to be a useful adjunct to the traditional practicum experience in reading diagnosis. Specifically, students appeared to gain increased awareness of the multiplicity of factors involved in reading difficulties and were better able to integrate the material. Future researchers could profit by delineation of the goals of the practicum experience and construction of simulations as adjuncts to teach those goals. Implementation of the information-processing model of human problem-solving in the area of reading diagnosis might then benefit both the learner and the instructor in graduate education.

1. The cooperation of Dr. Mary Farrell for implementation of this program is gratefully noted.

Table 1

Means and Standard Deviations of Final Examination Scores, Experimenter's Scorings

		Experimenter A		Experimenter B	
Score	n	mean	S.D.	mean	S.D.
Fall 1979	10	61.0	18.30	57.50	13.39
Spring 1980					
City College	14	54.29	14.79	53.21	18.17
Hunter College	13	62.11	24.96	54.23	24.27
Combined Scores City and Hunter	27	58.05	20.31	53.70	20.91

Table 2

Scheffé Post Hoc Comparisons Following the Significant Difference Between Conditions On A Combination of Parts 1 and 4 Of the Final Exam Question

Comparison	Test Statistic	Critical Value
Simulation only compared to simulation-child study	0.2551	8.6536
Simulation only compared to child study-simulation	1.7678	8.6536
Simulation only compared to child study	2.1706	8.6536
Simulation-case study compared to child study-simulation	4.5849	8.6536
Simulation-child study compared to child study only	1.2420	8.6536
Child study-simulation compared to child study only	11.1295*	8.6536
Average of simulation groups compared to child study only	6.0052	8.6536

*$p < .05$

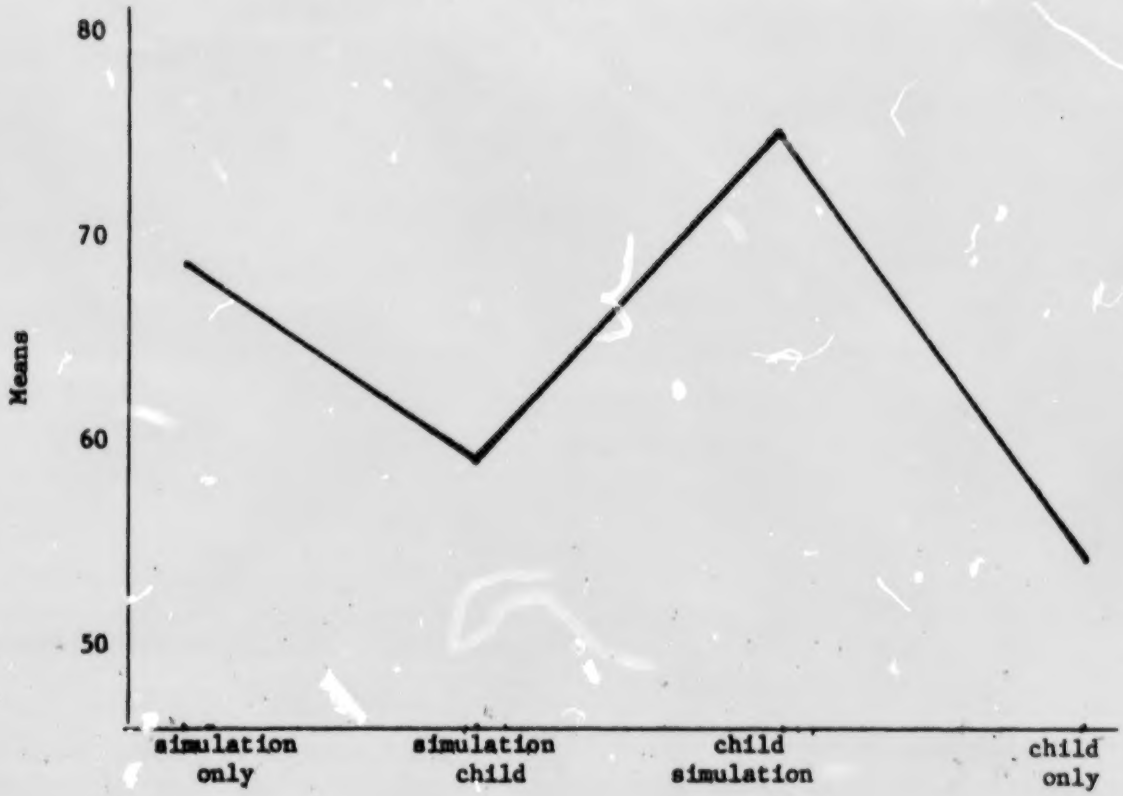

Figure 1. Mean score on the final exam question for subjects in each program condition.

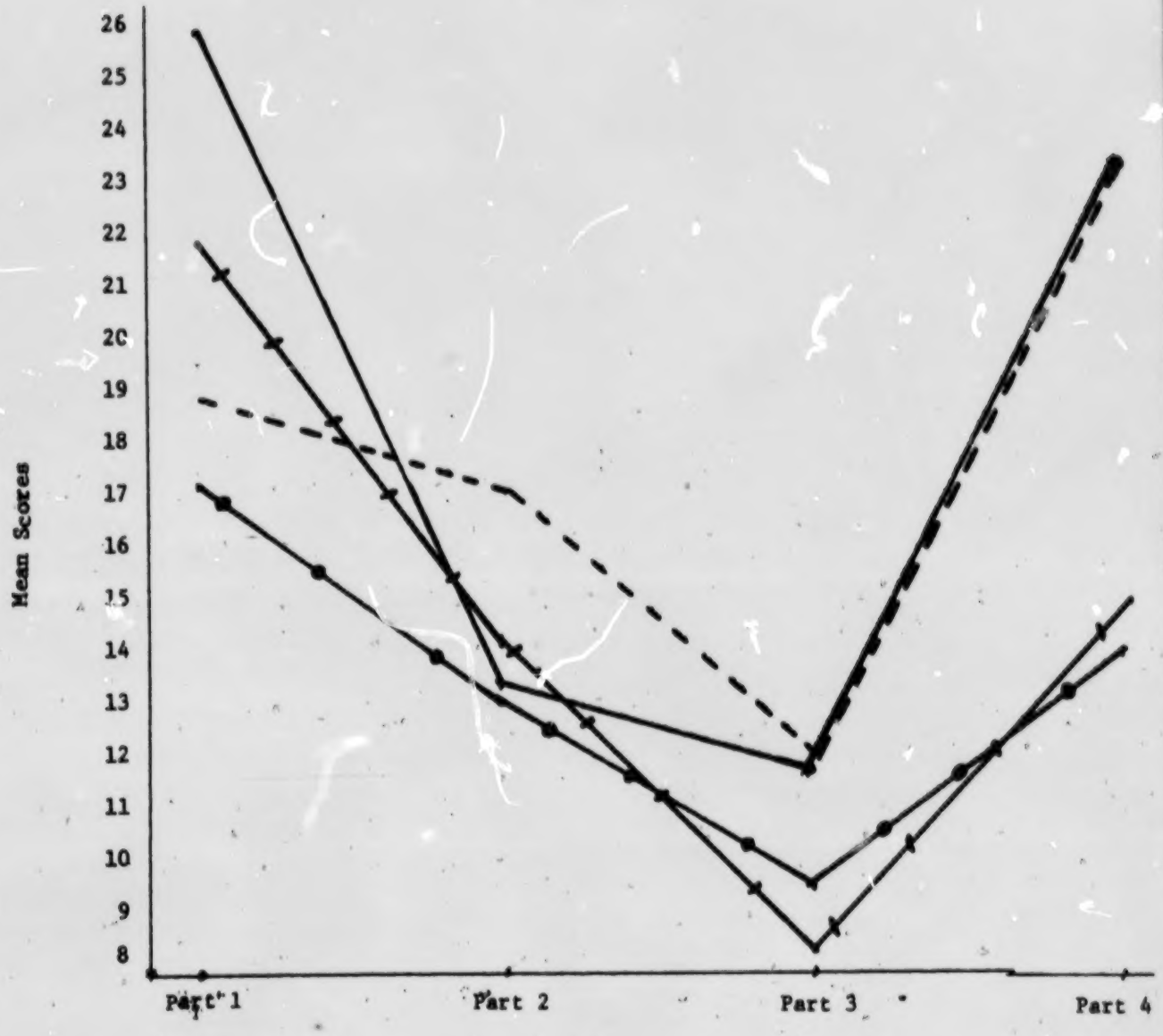

Figure 2. Mean scores on each part of the final exam question for all program conditions.

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